The influence of the abutment stiffness on the design of the new steel double track integral railway bridge in Mechelen

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Summary

In extending the existing railway infrastructure from Brussels to Antwerp, a new double track railway is foreseen in making a by-pass over the station in the city of Mechelen. In crossing a local canal a new railway bridge must be designed in front of historical steel Vierendeel bridges. The paper describes the final design of the new integral railway bridge contrasting in all aspects the Vierendeel bridges with revited bolt connections. The bridge consists of two lateral main girders with variable rectangular sections and is designed as an integral structure without bearings. The superstructure is fully welded and the main girder in box section near the abutments has a height of 3.65 m. The lower flange remains almost horizontal and is slightly twisted about a horizontal axis as it becomes wider at mid span. The upper flange decreases significantly and becomes smaller as it reaches mid span, obtaining less construction height of 1.65 m. This creates a waving pattern of the structure both in a horizontal plane as in the front view showing a contra bending referring to the arches of the Vierendeel bridges. The deck carrying both tracks consists of steel transverse girders with a concrete deck on top of it. The concept differs from a more classical integral bridge by totally stiff abutments. The paper describes the influence of the abutment stiffness as particular edge conditions in designing the main box sections taking all temperature effects. In addition, these abutments take part of a tunnel construction underneath the bridge. A parametric study of the abutment stiffness was needed. The advantage of the totally fixed portal structure has put into balance with the consequence of taking all temperature effects.

Keywords: Integral steel railway bridge, abutment stiffness, parametric study.

1. Introduction

In extending the existing railway infrastructure from Brussels to Antwerp, a new double track railway is foreseen as a by-pass along the railway station in the city of Mechelen. In combination to this project, a new road connection between the southern and northern part of the city as well as a new railway station will be built. In the southern part, this new road is situated in a tunnel under the by-pass railway. In designing the project, the process in obtaining a building permit in the city centre was very difficult dealing with historical and environmental conditions.

Fig. 1: Air photograph of the existing situation with view to the three Vierendeel bridges

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